Iridium-Based Catalysts with High Oxygen Evolution Performance for Proton-Exchange Membrane Water Electrolysis

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Abstract

Proton exchange membrane water electrolysis (PEM-WE) has emerged as a promising technology for hydrogen production and shows substantial advantages over conventional alkaline water electrolysis. To enable efficient PEM-WE in acidic media, iridium (Ir) or ruthenium (Ru) based catalysts are indispensable to drive the thermodynamically and kinetically demanding oxygen evolution reaction (OER). However, developing Ir/Ru catalysts with high efficiency and long-term durability still remains a formidable challenge. In this presentation, I will report our recent efforts to developing high-performance Ir-based OER electrocatalysts, including 1) ultrafine IrRu intermetallic nanoclusters supported on conductive, acid-stable tellurium nanoparticles (IrRu@Te)[1], which show enhanced catalytic activity and stability; 2) ultrafine vacancy-rich IrO_x clusters supported on high-surface-area titanate nanowires [2], revealing outstanding long-term stability at high current densities in strongly acid solution; 3) Self-supported nanoporous Ir-based electrodes serving as bifunctional catalysts for both OER and the hydrogen evolution reaction (HER).

References

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[2] Z. Yu, J. Xu, Y. Li, B. Wei, N. Zhang, H. W. Miao, A. Araujo, Z. Wang, J. L. Faria, Y. Liu, L. Liu, ACS Nano under review.

[3] Q. Li, J. Li, J. Xu, N. Zhang, Y. Li, L. Liu, D. Pan, Z. Wang, F. L. Deepak, ACS Appl. Energy Mater. Under review

Figures

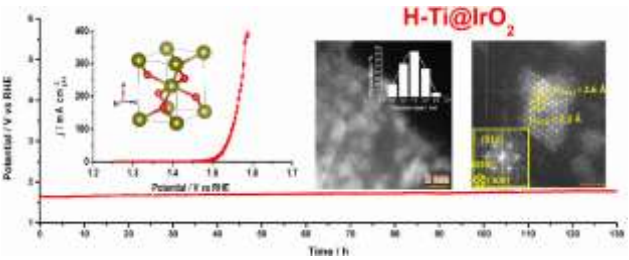

Figure 1: Long-term stability of vacancy-rich IrOx clusters at 200 mA cm^{-2}. Inset (left) OER activity; (right) TEM images of the clusters [2].

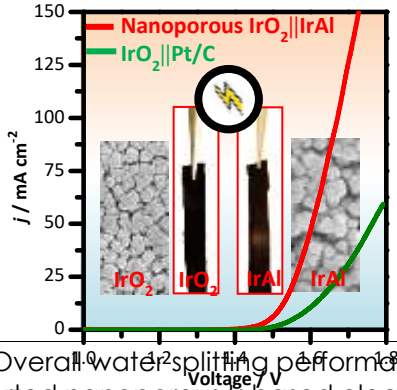

Figure 2: Overall water splitting performance of self-supported nanoporous Ir-based electrodes. Inset: SEM images and digital photographs showing the morphology of the electrodes [3].